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Case report

A case of mixed dust pneumoconiosis with desquamative interstitial pneumonia-like reaction in an aluminum welder

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ABSTRACT

A 60-year-old man presented with an 18-month history of gradually worsening cough and a 12-month history of dyspnea on exertion. High-resolution computed tomography showed bilateral uniform ground grass opacity in the lower lung fields, partially resolved by smoking cessation. A tentative diagnosis of desquamative interstitial pneumonia (DIP) was made. Video-assisted thoracic surgery was performed and pathological analysis showed peribronchiolar fibrosis with intra-alveolar macrophage infiltration. Elemental analysis detected aluminum and iron in the upper lobe and only iron in the lower lobe. Thus, a definitive diagnosis of mixed dust pneumoconiosis with DIP-like reaction was made. DIP-like reaction is known to be a reactive change caused by exposure to tobacco smoke as well as by inhalation of inorganic particles. Obtaining a detailed medical history including occupational and environmental risk factors is important to distinguish cases of DIP-like reaction due to exposure to inorganic particles from the usual cases related to smoking, and thus provide suitable treatment.

1. Introduction

Desquamative interstitial pneumonia (DIP), a condition associated with exposure to tobacco smoke, is one of the major idiopathic interstitial pneumonias. Characteristic signs include bilateral ground glass opacity with a predilection for the lower lung zone and peripheral predominance on chest radiography, and intra-alveolar accumulation of macrophages pathologically [1]. Bedrossian et al. proposed the term “DIP-like reaction” to describe the accumulation of macrophages in the alveoli surrounding various lesions, such as rheumatoid nodule, eosinophilic granuloma, intrapulmonary lymph node, and chondromatous hamartoma [2]. Also, some cases of aluminum lung, welder's lung, or asbestosis show pathological features of DIP [3–9].

In this report, we describe a case of pneumoconiosis in an aluminum welder with radiological findings suggestive of DIP and a pathological diagnosis of interstitial pneumonia mainly dominated by a DIP-like reaction.

2. Case report

A 60-year-old Japanese man presented to our hospital with a 12-month history of dyspnea on exertion. He also had a cough that had gradually worsened over the past 18 months. A routine medical check-up had detected an abnormal shadow on chest X-ray, but no treatment was instituted and he was only observed. He had a past medical history of diabetes mellitus and hypertension and a history of heavy smoking (60 pack-years). He worked in aluminum processing, involving casting aluminum into molds for engine covers and polishing the workpieces. His work also sometimes involved polishing steel.

On examination, his vital signs were normal, with peripheral oxygen saturation of 95%, respiratory rate of 18 breaths per minute, and temperature of 36.7 °C. There was finger clubbing with fine crackles at the lung bases on auscultation. C-reactive protein was elevated to 2.02 mg/dl, and Krebs von den lungen-6 and surfactant

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Abbreviations

HRCT	high-resolution computed tomography
DIP	desquamative interstitial pneumonia
VATS	video-assisted thoracic surgery
GGO	ground grass opacity
f-NSIP	fibrotic nonspecific interstitial pneumonia

protein D were elevated to 1996 U/ml and 160 ng/ml, respectively. Antibodies associated with collagen vascular disease had low titers. Chest X-ray showed ground glass opacity (GGO) in both lower lung fields. High-resolution CT (HRCT) showed emphysematous change and mild GGO in the upper lobes (Fig. 1A), and uniform GGO in the lower lobes (Fig. 1B).

We suspected the possibility of DIP and recommended smoking cessation, following which the GGO at the lower lobes regressed to some extent, though not completely (Fig. 1C and D).

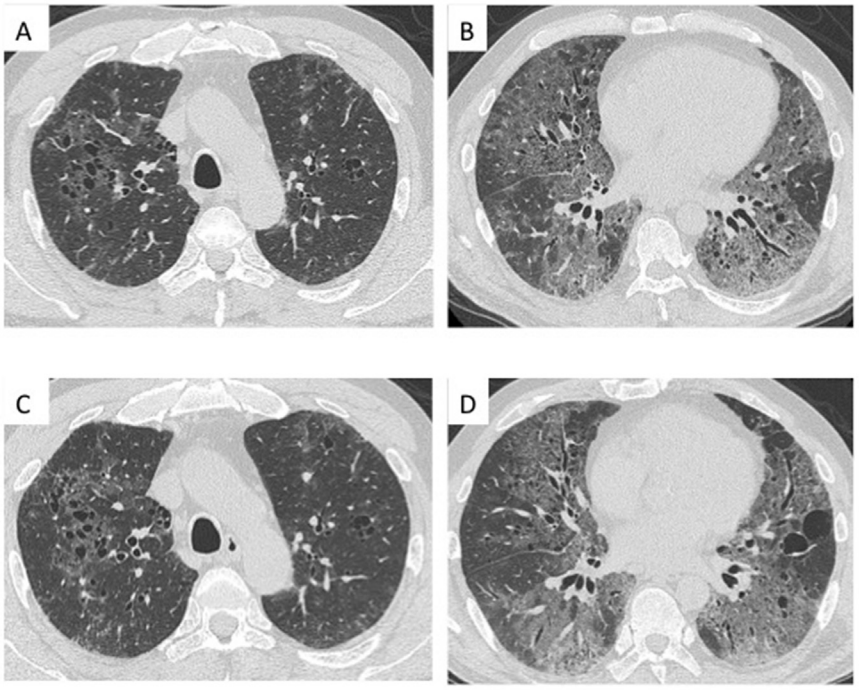

Fig. 1. HRCT scans of the chest. (A, B) At initial presentation: Emphysema and mild GGO in the upper lobes, and uniform GGO with lower zone predominance. (C, D) After smoking cessation: Little change is evident in the upper lobes, while bilateral shadows in the lower lobes show mild improvement.

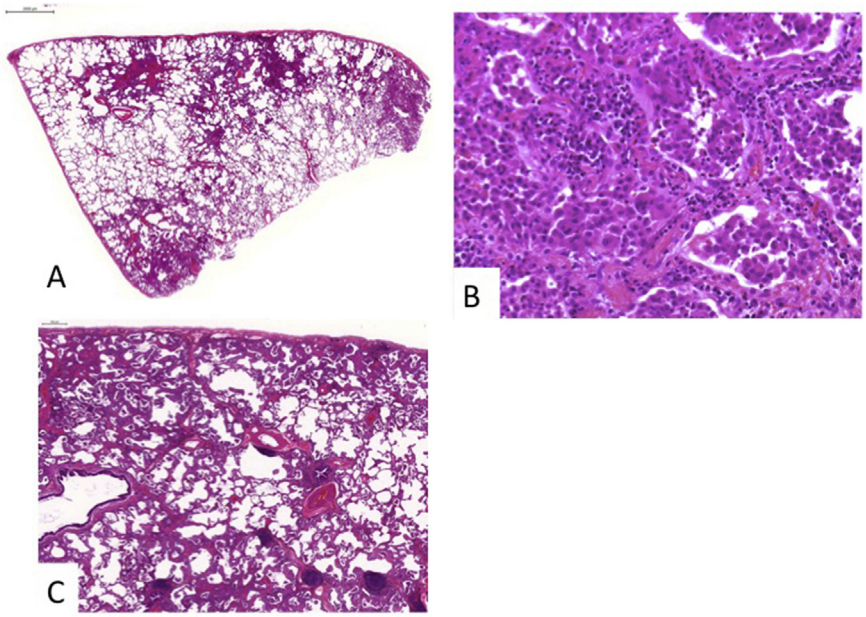

Fig. 2. Pathological findings from VATS lung biopsy. (A) Right. S2: Panoramic view showing bronchiolocentric accentuation of macrophage accumulation and peribronchiolar fibrosis. (hematoxylin-eosin, × 1), (B) Right. S2: Large macrophages admixed with eosinophils in the alveolar lumina and infiltration of plasma cells in the alveolar walls. (hematoxylin-eosin, ×20), (C) Right. S8: Fibrotic NSIP with mild accumulation of macrophages in the alveolar lumina and lymphoid follicles. (hematoxylin-eosin, ×3).

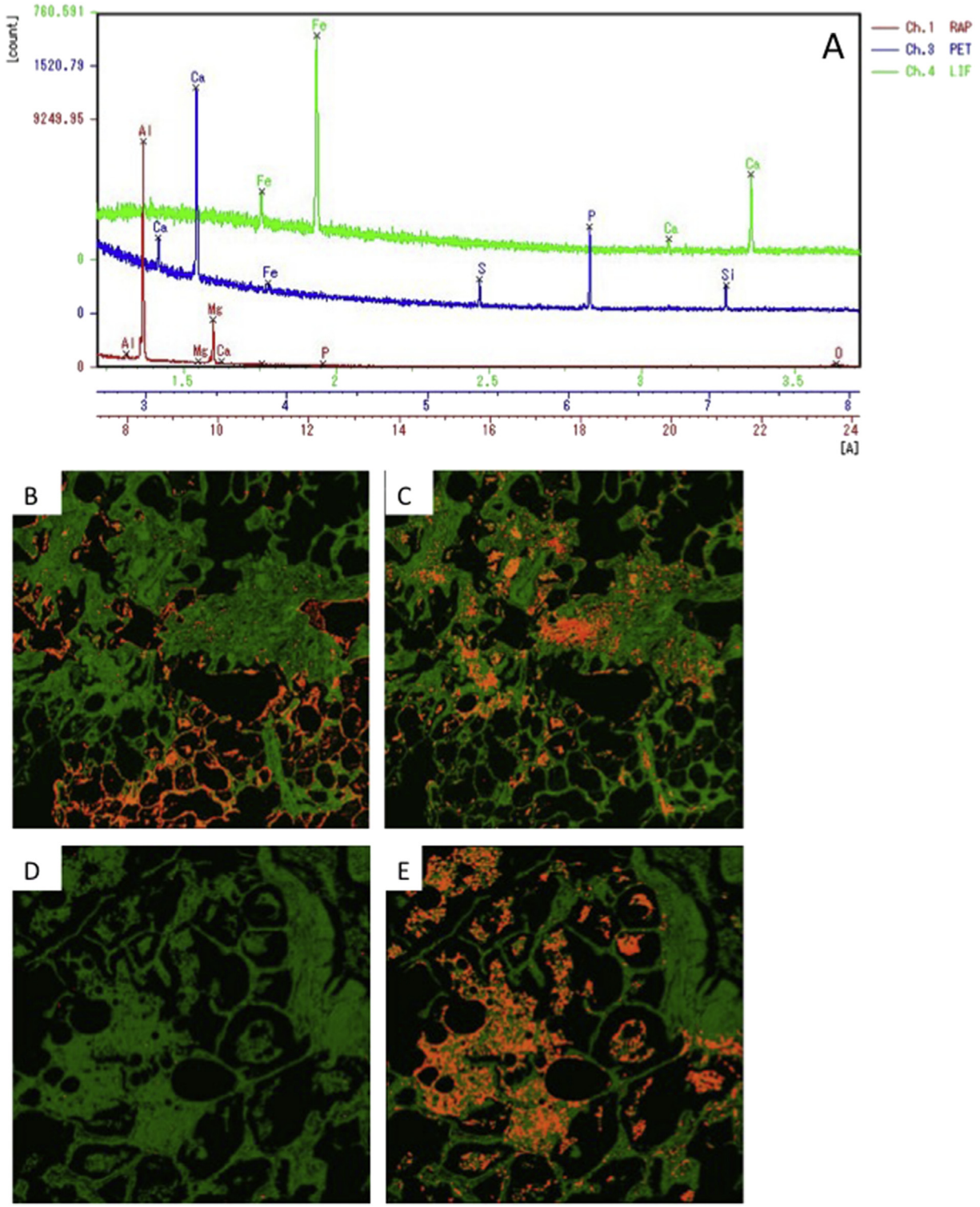

Fig. 3. Elemental analysis. (A) Quantitative elemental analysis of the right S2 lesion shows characteristic X-ray features on the horizontal axis and intensity on the vertical axis. This indicates high levels of aluminum deposition. (B–E) Elemental analysis showing nitrogen (green) and other particles (orange). S2 lesions with deposition of aluminum (B) and iron (C). Right S9 lesion shows no deposition of aluminum (D), but there is deposition of iron (E).

Bronchoalveolar lavage fluid revealed a total cell count of 4.6×10^5 comprising 51.0% macrophages, 30.5% neutrophils, 5.8% lymphocytes (CD4/8 ratio 0.62), and 12.7% eosinophils. These results further supported a diagnosis of DIP. Thus, we conducted video-assisted thoracic surgery (VATS) to establish a definitive diagnosis. Histopathological findings of biopsy specimens showed bronchiolocentric-accentuated accumulation of macrophages, and peribronchiolar fibrosis in a right S2 lesion (Fig. 2A and B). Another specimen from right S8 showed fibrotic nonspecific interstitial pneumonia (f-NSIP) with mild accumulation of macrophages in the alveolar lumina and lymphoid follicles (Fig. 2C).

Elemental analysis was performed at Niigata University

Graduate School of Medical and Dental Sciences to measure the relative amounts of aluminum and other particles compared with the amount of nitrogen. High amounts of aluminum were detected in S2 and high levels of iron in S2 and S9 (Fig. 3A–E). Based on these findings, the main pathological feature of this case of interstitial pneumonia was considered to be a DIP-like reaction from inhalation of inorganic particles. Avoiding exposure to these inorganic particles in workplace as well as smoking cessation and steroid therapy was started (prednisone 30 mg/day) and the GGO had mostly disappeared within 3 months.

3. Discussion

We encountered here a case of interstitial pneumonia in an aluminum welder. The main radiological features were bilateral GGO in the lower lung fields and pathologically bronchiolocentric accumulation of macrophages with peribronchiolar fibrosis. In 1965, Liebow et al. proposed the concept of DIP to describe the pathological findings in interstitial pneumonia with desquamation of epithelial cells as a defining characteristic [10]. Eventually, the term “desquamation” was found to be a misnomer and the essential characteristics were recognized as infiltration of macrophages into the alveolar spaces [11]. In 2002, a joint statement by the American Thoracic Society and the European Respiratory Society observed that the distribution was uniform, lacking the bronchiolocentric distribution seen in respiratory bronchiolitis [1]. Thus, we considered the present case to be distinct from the usual findings of smoking-related DIP.

Pathological findings resembling DIP have also been reported in non-smokers. For example, Bedrossian et al. reported cases where large monocytes infiltrated alveolar spaces surrounding various lesions, such as rheumatoid nodule, eosinophilic granuloma, intrapulmonary lymph node, and chondromatous hamartoma, and named them “DIP-like reactions.” These pathological changes are also seen in occupational lung diseases such as asbestosis [8,9]. In 1982, Herbert et al. reported a case of DIP complicated by aluminum lung [4]. However, pathological diagnosis of this case was based on the older definition of diffuse interstitial pneumonia with desquamation, with apparently no reference to the macrophage distribution. Several cases of DIP with welder's lung have previously been reported, but most authors mentioned only the diagnosis, not the precise pathological findings [6,7]. In the present case, however, there was a clear history of exposure to aluminum and iron dust, and pathological findings showed macrophage accumulation in the alveolar ducts with fibrosis along the respiratory bronchioles and deposition of aluminum and iron in the lung tissue. Therefore, these changes are considered a DIP-like reaction likely due to occupational exposure to these inorganic particles.

Large amounts of aluminum with concomitant macrophage infiltration and mild fibrosis were detected in the upper lobes indicating the changes induced by aluminum inhalation. However, aluminum was not detected in the GGO of the lower lobes with pathological f-NSIP, but iron was detected. This pathological change cannot be explained only by a diagnosis of aluminum lung. A study by Travis et al. highlights the difficulty in identifying the causative agent of pneumoconiosis from pathological patterns since mixed dust exposure is common [12]. In our case, aluminum dust, iron dust, and tobacco dust were all potential causative agents associated with these pathological changes. Therefore, we thought it appropriate to classify this case as “mixed dust pneumoconiosis” rather than “aluminum lung.” Moreover, it was significant that we could compare the aluminum distribution between the upper and lower lobes. In aluminum lung, the aluminum distribution in the upper lobes accounts well for the radiological features of aluminum lung; very few reports have confirmed this by elemental analysis, as we were able to do in the present case. As such, our case is clinically relevant and significant.

In this report, we have described a case of interstitial pneumonia pathologically characterized mainly by f-NSIP with a DIP-like reaction in a heavy smoker who worked as an aluminum welder. Because elemental analysis detected high levels of aluminum and iron, no single type of particle could be named as the causative agent of these changes and should be considered as mixed dust lung disease; hence, we diagnosed “mixed dust pneumoconiosis”. Avoiding exposure to these causative agents may improve the prognosis, and it is important for treatment to distinguish such cases from the usual smoking-related DIP.

Conflicts of interest

None.

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